NOTES ON AN ICHNEUMONID PARASITE (HYMENOPTERA) OF PARASA CONSOCIA (LEPIDOPTERA)

SETSUYA MOMOI, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan and* KICHIRO OKAMOTO, *Hyogo University of Agriculture, Hyogo, Japan*

This paper gives taxonomic and biological accounts of an ichneumonid parasite of *Parasa consocia* Walker, a moth that defoliates poplar in Japan.

This parasite, *nohirai* Uchida, was originally described in *Plectocryptus*, but it differs from the type-species *Plectocryptus digitatus* (Gmelin) in several important characters. These are: a shorter mandible with the upper tooth longer than the lower one, the areolet of the forewing being large and parallel-sided, and the dorsal valve of the ovipositor with transverse apical ridges. It differs also in several minor characters. Because there seems to be no real reason for placing this species in *Plectocryptus* a new genus is described herein with *nohirai* Uchida as type-species.

Biological investigation on this ichneumonid was done mainly in the fall of 1954 at Sasayama, Hyogo, Japan by Momoi and supplemental accounts were gathered in the fall of 1962 at the same place with the aid of Okamoto.

We are greatly indebted to Dr. Henry Townes of the American Entomological Institute and Miss Luella Walkley of U.S. National Museum for their kind suggestions and for reading the manuscript.

Litochila, genus novum

"Undescribed genus" Townes et Gupta, 1962. Mem. American Ent. Inst. 2: 6.

This genus belongs to the tribe Hemigasterini of the subfamily Gelinae. Judging from the shape of the mandible and the ovipositor tip, it is most closely related to *Mansa* and *Hemigaster* as noted by Townes and Gupta (1962) under the name of "undescribed genus from the eastern Palearctic." *Litochila* may be distinguished from them as well as the other genera of the tribe by the following combination of characters:

Mandible rather short, with lower tooth distinctly shorter than the upper. Clypeus weakly convex, large, its apical margin thin and straight. Flagellum cylindrical, broadened medially in ♀, the tyloids on male flagellum long-oval to linear, beginning on segments 12 to 15 and occurring on about 4 to 10 segments. Notaulus distinct. Sternaulus complete to posterior rim of mesopleurum and ending just below lower posterior angle of the pleurum. Propodeum short, the dorsal face distinctly set off from the posterodorsal face by a sharp angulation, and much shorter than the latter. Apophyses only weak crests. Propodeal spiracle elongate oval, about twice as long as wide. Areolet very large, pentagonal, parallel-sided, receiving second recurrent approximately at middle. Ovipositor straight, sagitate at apex, its dorsal valve with some distinct apical transverse ridges.

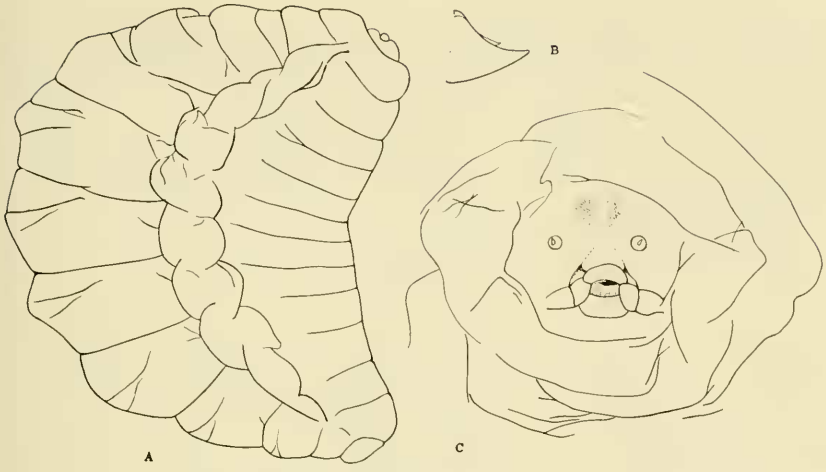

Fig. 1. *Litochila nohirai*, overwintering mature larva. A, whole body in side view; B, right mandible; C, face in frontal view.

Type-species: *Plectocryptus nohirai* Uchida

Three described species referable to this genus are: *Plectocryptus nohirai* Uchida, *Plectocryptus jezonicus* Uchida and *Cryptus carbonarius* Smith (= *Plectocryptus saitamensis* Uchida, **new synonymy**[1]). These species are new combinations in *Litochila*.

Litochila nohirai (Uchida)

Plectocryptus nohirai Uchida, 1930. Jour. Faculty Agr., Hokkaido Imp. Univ. 25: 324. ♂, ♀.

Redescription of the species from available material is as follows:

Body covered with golden hairs. Face and frons shagreened, with fine and very dense punctures. Temple and cheek dull in ♀, shiny in ♂, with fine dense punctures, the punctures becoming more dense on the upper portion, and on vertex. Malar space shagreened, without punctures. Clypeus shagreened basally, polished apically, with fine dense punctures except on its apico-median portion, its apical portion flattened and with no transverse impression along the apical margin. Frons with a nearly triangular impression just below median ocellus, its antennal scrobe concave and rugose. Flagellum 34 to 38-segmented, with tyloids on segments 13 to 22 of ♂. Mesoscutum mat in ♀, polished in ♂, with fine and very dense punctures. Scutellum weakly convex, weakly narrowed backwards, with a lateral carina at extreme base. Mesopleurum of ♀ rugose and rugose-punctate, the sculpture becoming somewhat coarser and reticulate below speculum and being replaced with weak punctures before speculum. Meso-

[1] I am indebted to Dr. H. Townes who confirmed this synonymy by comparing representatives of *saitamensis* with the type of *carbonarius* at the British Museum (Nat. Hist.) in London.

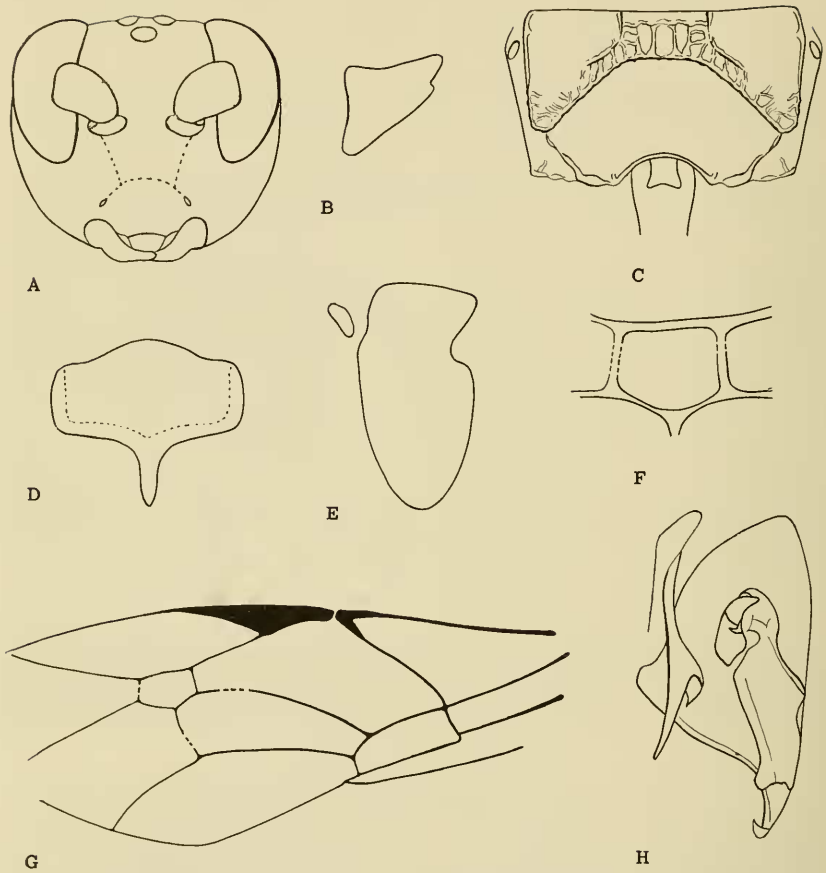

Fig. 2. *Litochila nohirai*, adult. A, head in frontal view; B, right mandible; C, propodeum in dorsal view; D, ♂ subgenital plate; E, ♂ postgenital plate; F, areolet of forewing; G, part of forewing; H, right half of ♂ genitalia.

pleurum of ♂ essentially similar to that of ♀ but much less strongly sculptured, with an unsculptured area just before speculum. Metapleurum reticulate-rugose. Propodeum finely reticulate-rugose, the first lateral area densely punctate rather than reticulate-rugose. Areola usually with four longitudinal rugae. Basal area strongly transverse, smooth. Tergites polished, with fine, very dense punctures. Postpetiole with a distinct unsculptured median area at apex. Tergite 2 with no median unsculptured area. Nervellus broken at lower 0.2. Ovipositor sheath about 0.4 as long as forewing. Forewing of ♀ ca. 12 to 15 mm., of ♂ ca. 10 to 13 mm.

♀. Black. Palpi, mandible except teeth, clypeus apically, a small spot on orbit of vertex, tegula, subtegular ridge, apical half of tergites 1 and 2, and greater part of tergite 8, reddish brown. Tergite 3 with a reddish brown post-

median transverse band. Face with a small reddish tinge along orbit near antennal socket. Lateral crests of propodeum, reddish. Ovipositor sheath yellow at apex. Antenna reddish brown, paler toward apex, the segments beyond 13 black. Legs reddish brown. Hind and middle coxae black; fore coxa usually black or nearly so; wings tinged with yellow.

♂. Black. Palpi, mandible, clypeus, face, cheek, frontal orbit to top of head, pronotum along anterior margin, humeral angle, tegula, scutellum, propodeum in greater part, tergite 1 except base, and apical half of tergites 2 and 3, reddish brown. Antenna reddish brown, the flagellar segments beyond 13 or 14 black. Legs reddish brown. Fore and middle coxae blackish in part. Hind coxa black with a reddish brown mark of variable extent. Wing tinged with yellow.

Specimens examined: Numerous ♂, ♀, reared from *Parasa consocia* in 1954 and 1962 at Sasayama, Hyogo, Japan.

Distribution: This species occurs in Japan on Honshu and Shikoku islands, in Korea and in northern China.

Litochila nohirai may be distinguished from the other congeneric species by the following key:

1. Body covered with golden hairs; wing tinged with yellow; scutellum, postscutellum and apical half of tergite 2 reddish brown; clypeus flat apically, with no preapical transverse impression; ♀ : Mesoscutum strongly mat between dense punctures; tergite 2 with no unsculptured area. ♂ : Tyloids on approximately 10 median flagellar segments; face and hind tarsus reddish brown throughout ..... **nohirai** (Uchida)

   Body covered with fuscous to black hairs. Wing hyaline. Scutellum, postscutellum and tergite 2 completely black. Clypeus with a distinct preapical transverse impression and its apical margin more or less reflexed 2

2. Face black with white orbital area. ♀ : Mesoscutum strongly mat between dense punctures. Tergite 2 with no unsculptured area. ♂ : Tyloids on approximately 7 median flagellar segments. Hind tarsus black throughout ..... **jezonica** (Uchida)

   Face completely black. ♀ : Mesoscutum polished between dense punctures. Tergite 2 with a large unsculptured area medially. ♂ : Tyloids on approximately 4 median flagellar segments. Hind tarsus black, with a white median ring ..... **carbonaria** (Smith)

Bionomics

Litochila nohirai is a solitary ectoparasite. It attacks larvae of *Parasa consocia* in the overwintering cocoon stage parasitizing a high percentage of them. The host insect is one of the serious defoliating pests of poplar in the Kinki district of Japan. According to our own observation it seems to have only one generation a year, hibernating in the larval stage within its cocoon on the ground near the host plant.

Parasitization and general behavior.—In the summer and the early fall of the years 1954 and 1962, a total of 263 cocoons of *Parasa consocia* were collected on the campus of the Hyogo University of Agriculture.

Of these cocoons, 113 contained larvae of *nohirai*; 45 contained larvae of the host dead in their mature stage; and only 105 contained living mature larvae of the host. The percentage of parasitism by the ichneumonid thus averaged 46.8% in these years. The number of the cocoons collected and their contents are as follows:

	1954	1962	Total
No. cocoons collected	54	209	263
No. cocoons containing living *consocia* larva	3	102	105
No. cocoons containing dead *consocia* larva	20	25	45
No. cocoons containing living *nohirai* larva	31	82	113

The ichneumonid larvae pupated from middle to late October, and adults emerged from the cocoons from early to middle November. The emergence of adults from the collected cocoons are as follows:

	1954	1962	Total
No. adults emerged	28 ♂ ♀	21 ♂, 32 ♀	81 ♂ ♀
No. larvae or pupae died	2	25	27
No. living larvae	1	4	5

From 113 parasitized cocoons only 81 ichneumonids emerged; the other larvae or pupae died of disease or by accident except 5 which were still in the larval stage after the other larvae had become adults. Of the 53 adults that emerged from the cocoons in the fall of 1962, 32 were females. We fed the ichneumonid females with diluted honey. Some of them lived more than one month, until the middle of December, in captivity. Without mating they oviposited in cocoons containing hibernating larvae of *Parasa consocia* given them nearly one month after their emergence, paralyzing the host larvae by penetrating the host cocoons with the ovipositor. Eggs were laid loosely on the host larva or between the host body and the cocoon wall. About 6 to 8 days after the deposition of the egg, the first instar larva eclosed. It fed externally on the paralyzed host larva and grew very slowly. When its prey had been sucked, the parasite larva spun a large oval cocoon inside the host cocoon, discharged a dark brown meconium at the bottom of the cocoon, and rested in the cocoon until the fall of the next year.

Egg-laying habits.—Egg-laying habits were observed in a small glass cylinder of about 10 cm in diameter. When host cocoons were put into the vessel with females of the ichneumonid that had been kept alive for a long time after emergence, each female soon showed interest in a cocoon, walking about on it tapping it with her antennal tips and raising her abdomen and curving it strongly downwards the ovipositor with its sheath stretched straight under her body. When a suitable point was found, she made a serious effort to penetrate the cocoon with the ovipositor, roundly turning the ovipositor and stress-

ing her body again and again toward the host cocoon. At first the sheath enclosed the ovipositor but when the tip of the ovipositor penetrated the cocoon wall, the sheaths curved gradually away, leaving only the ovipositor tip at the working point, and at last curled backward. The female keeping her ovipositor in the small hole she had made inserted it farther inward twice or thrice. In three instances the time spent to oviposit in a single host was about 50 to 60 minutes. In general, only a single egg was deposited in a host cocoon, although it was not rare to find two or three, or sometimes four or five eggs on a single host. In each case, only a single ichneumonid larva remained alive. On December 2 and 3 of 1954, five eggs were deposited on a host larva by a female. Six days later, we found the young larva that first eclosed devouring the other eggs laid by the same mother wasp.

On December 4 of 1954, we put two cocoons of *Parasa consocia*, each containing a mature larva of *Litochila nohirai*, into a vessel with a female of the ichneumonid that had emerged on November 9 of 1954. After two days, we found three eggs on one of the ichneumonid larvae. The larva was not paralyzed at all.

Egg, larva and cocoon.—The egg is spindle-shaped, glossy and lemon yellow in color, measuring about 2.3 to 2.5 mm in length and about 0.5 to 0.8 mm in width across the broadest section. The first instar larva is of the vesicle-bearing form with distinct antennae, lemon yellow in ground color with the cephalic and caudal segments white. The final instar larva is of a normal form for ectoparasitic Hymenoptera, and is also glossy and of lemon yellow color. Each of dorsal segments 1 to 10 has a transverse median swelling, those of segments 3 to 9 composed of numerous small rugulae. The mandible has a small tooth and inconspicuous pectination on the inner side of the blade. The antenna is subconical and distinct. On the upper side of the face there is a pair of fuscous spots. The cocoon is composed of a few thin layers, of which the outer one is dark brown and the rest almost white. In general form, the cocoon is short ovoid and in its greater part is attached to the inner side of the host cocoon. Between the walls of the host and parasite cocoons are found always the host remains. The caudal end of the parasite cocoon contains a brown meconium.

Parasa consocia Walker (Heterogeneidae) is the only host known